

# **Reexamination of “On the Determination of Climate Feedbacks from ERBE Data”**

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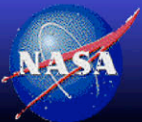
Chris O'Dell

Colorado State University, Fort Collins, Colorado

CERES Science Team Meeting

Fort Collins, Colorado

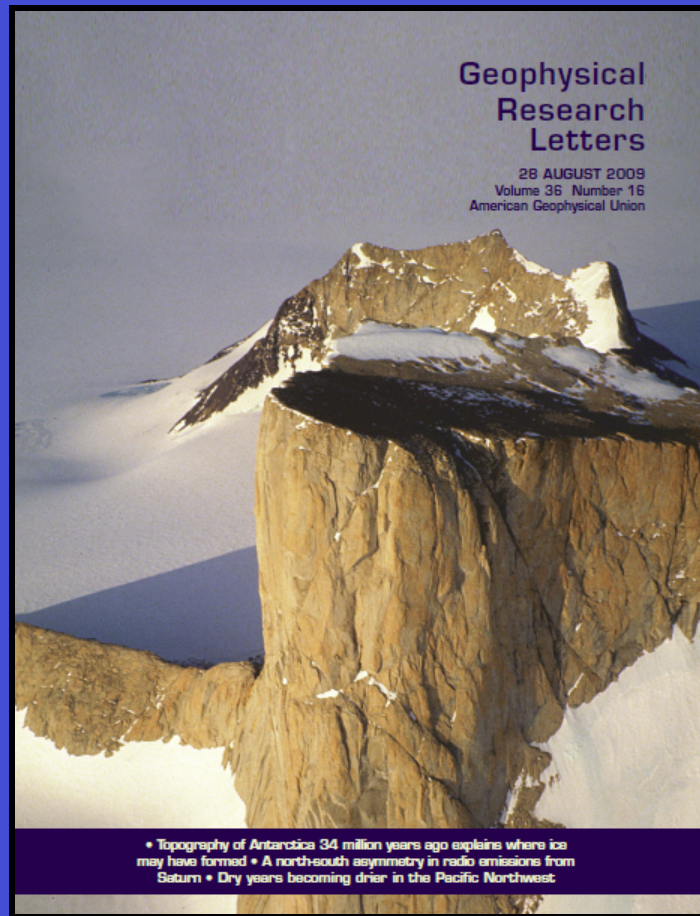
3-5 November, 2009



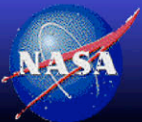
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# Motivation

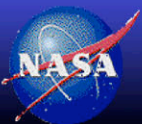
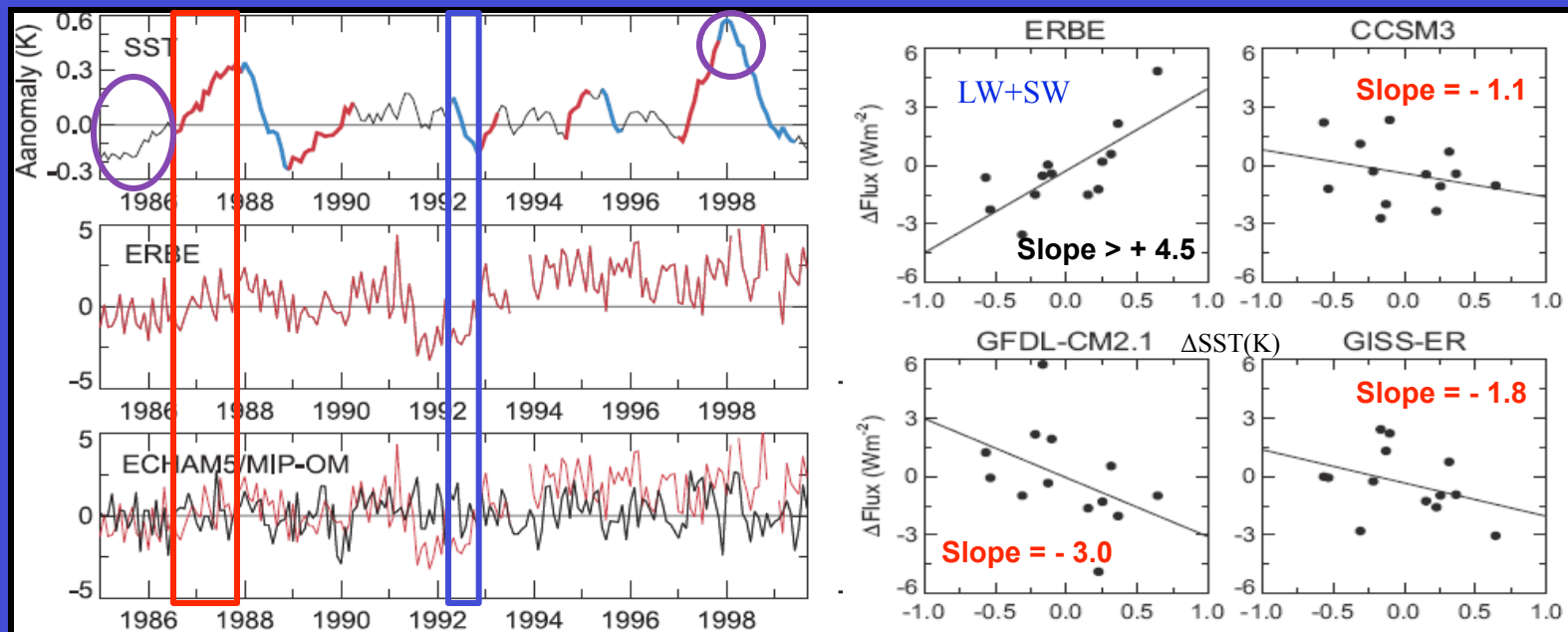


- Lindzen and Choi recently published a GRL paper (August 2009 issue) entitled, “On the Determination of Climate Feedbacks from ERBE Data”
- They found that the observed total outgoing radiations (LW+SW) in the tropics increase dramatically with SST while the GCM results behaved in the completely opposite fashion.
- Since the CERES/ERBE team was not involved during the paper review process, we were surprised to see such a large difference between ERBE observations and Models. We decided to take a closer look at their analysis.



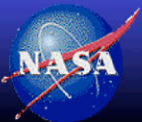
# Overview of Lindzen and Choi (LC2009)

- ERBS Nonscanner Edition3 monthly data (1/85 to 9/99), NCEP SST, and results of 11 AMIP models from the AR4 archive.
- Based on tropical mean (20n to 20s) deseasonalized time series.
- Further sub-sampled the data using a threshold technique, which is based on minimum SST change (i.e., 0.2 K). Changes (in SST or Fluxes) are calculated using differences between beginning and ending points.



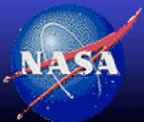
## **Possible Problems with their Results**

- LC2009 is not using the latest ERBE data (Edition3\_Rev1)
- The “starting point and ending point” method may be statistically unreliable
- Low data count makes it impossible to assign uncertainty to their results
- It also appears that LC2009 have subjectively removed some data points from the analysis without any explanations
- Use of monthly data, instead of the 36-day mean, also added noise to the analysis due to sampling issue



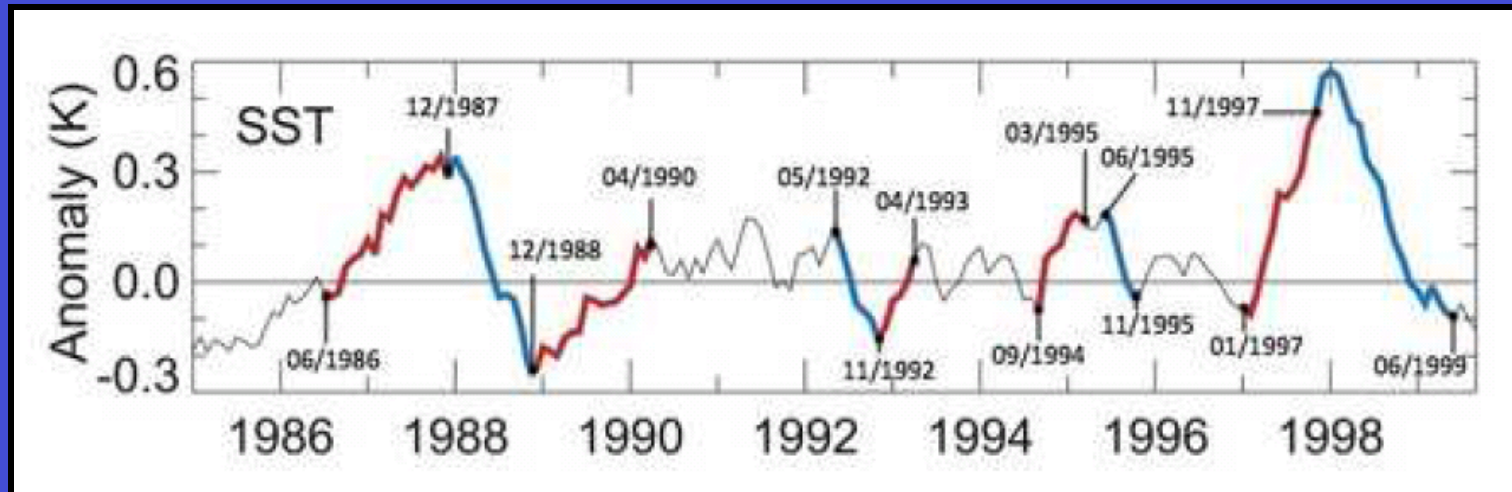
## Datasets

- Reynolds and Smith OISSTv2
- ERBE/ERBS WFOV Edition3 and Edition3\_Rev1 monthly and 36-day mean
- 9 AMIP model results from the AR4 archive

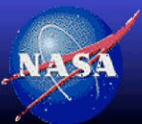




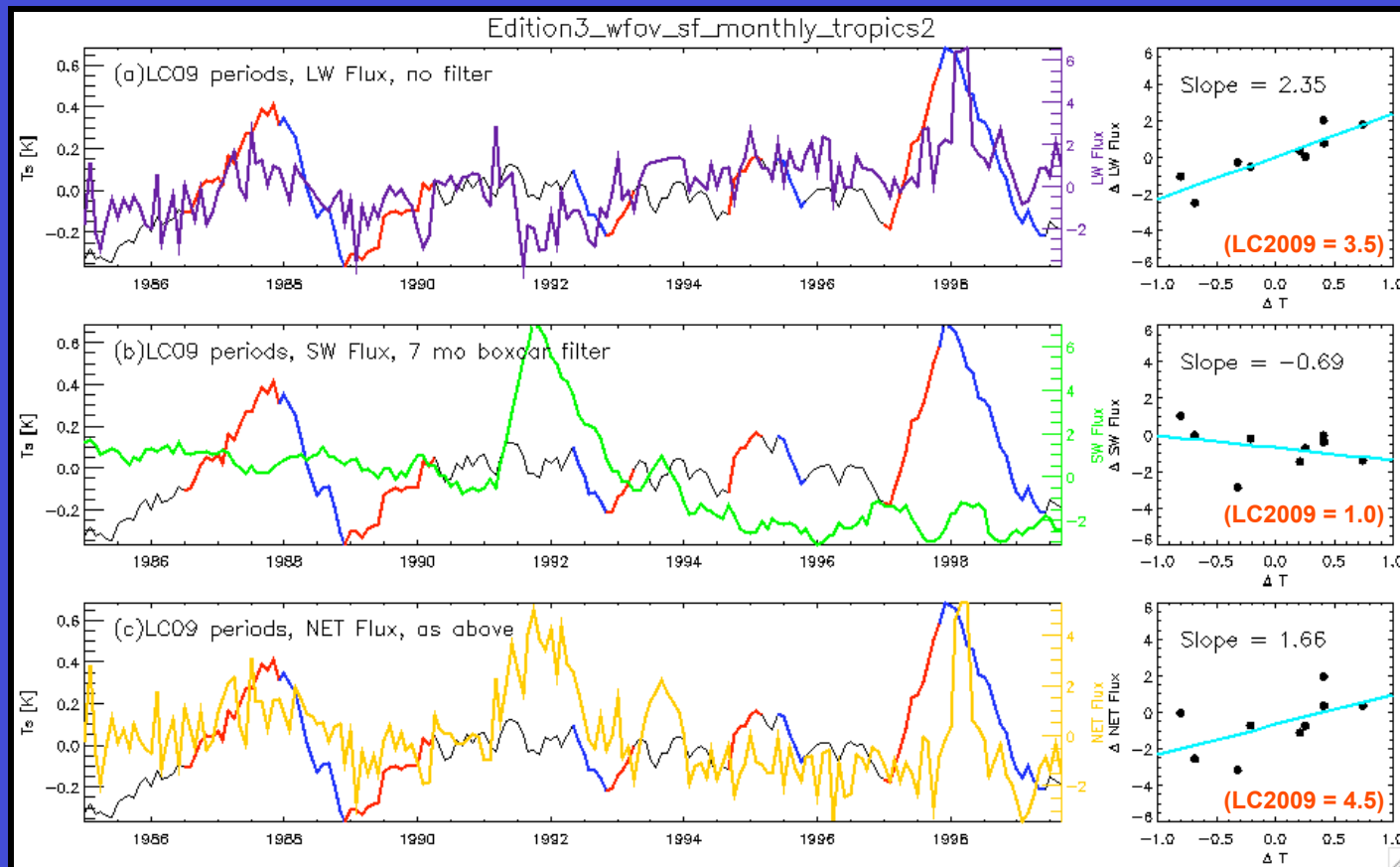
## Identifying the Data Periods



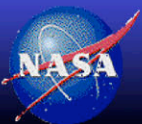
- Since the short GRL paper lacks specific details, we can only reproduce the 0.2 threshold case in LC2009 using the SST figure in their paper → Nine periods
- We find matching pair data for both ERBE data (Ed3 and Ed3\_Rev1) and 9 AMIP model results



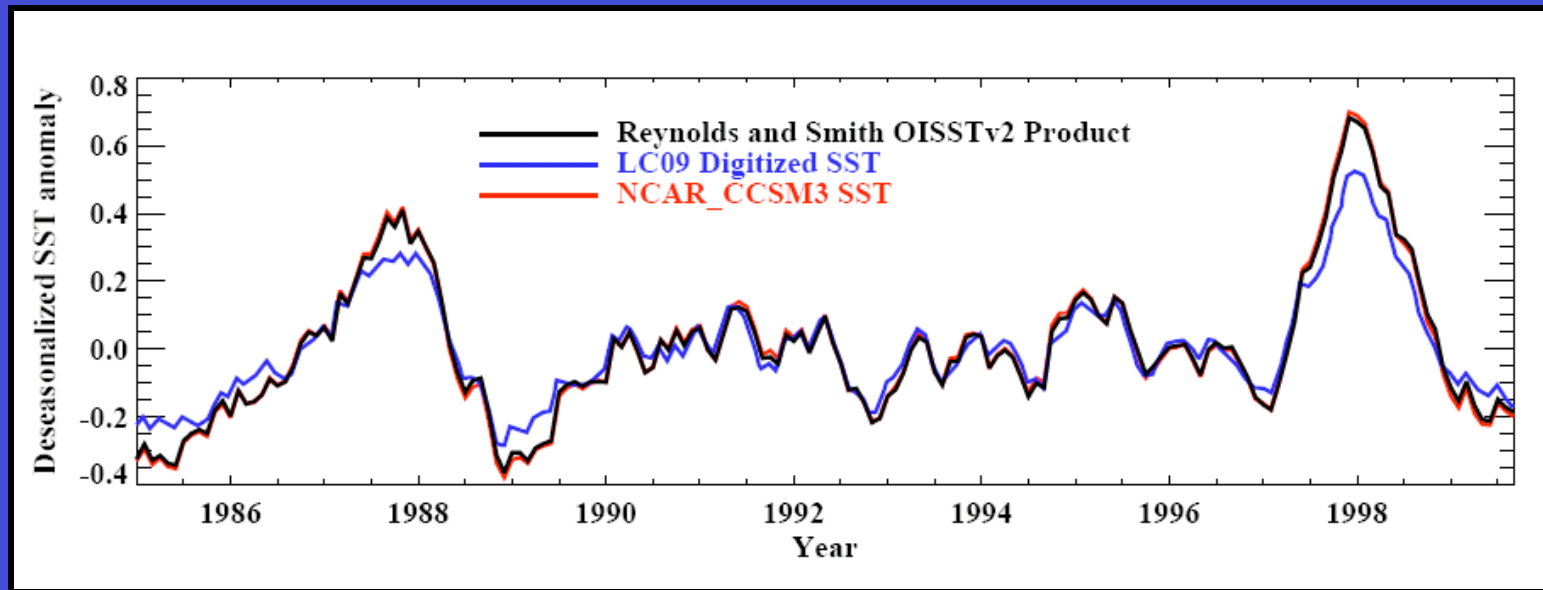
# LC2009 Method: ERBS Nonscanner Ed3 Results



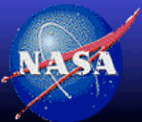
- We can not reproduce LC2009 results (in red) from ERBS WFOV Ed3 data. Their LW results are too high, SW results have the “wrong sign”; leading to LW+SW results having extremely high positive values



# SST Dataset



- The larger LW flux changes with SST in LC2009 may be partially due to the SST data they use in the analysis.
- Their SST data tends to have smaller amplitudes than other SST datasets, which will result in a larger LW sensitivity.

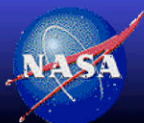




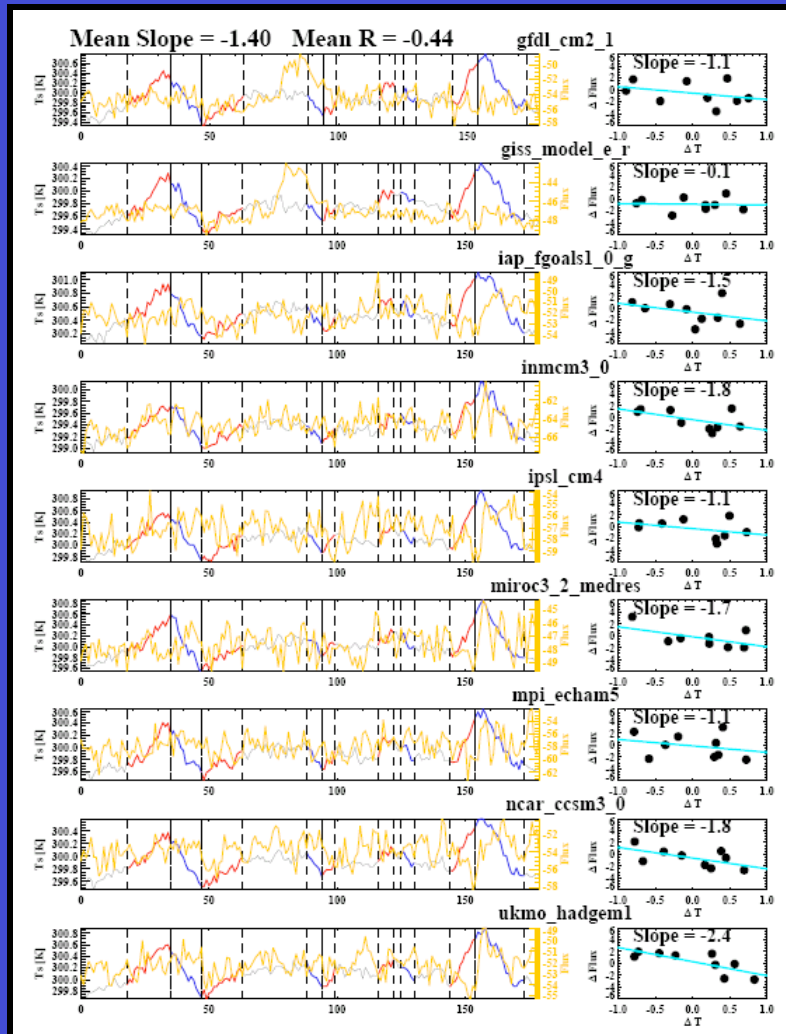
## Exploring Other Data Issues with LC2009

	<i>LC2009 results (GRL)</i>	LC2009 periods Ed3	LC2009 periods Ed3_Rev1	LC2009 periods smooth_alldata	LC2009 periods + smooth_alldata + ENSO98_1month
LW	<b>3.5</b>	2.4	2.3	1.8	2.9
SW	<b>1.0</b>	-0.7	-0.7	-1.3	-0.4
LW+SW	<b>4.5</b>	1.7	1.6	0.5	2.5

- LC2009 total flux (LW+SW) changes with SST is too large (4.5 Wm<sup>-2</sup>/K) due to lack of SW compensation to offset the larger LW effect
- LC2009 method is not affected by Rev1 correction.
- LC2009 applied a 7-month smoother only to the SW data. This reduces their shortwave results relative to the longwave counterpart. Applying smoother to all data reduces the total flux results to just 0.5 Wm<sup>-2</sup>/K
- LC2009 method is statistically unreliable; changing endpoint by one month can significantly change the outcome of the total flux results (500% increase in example above).



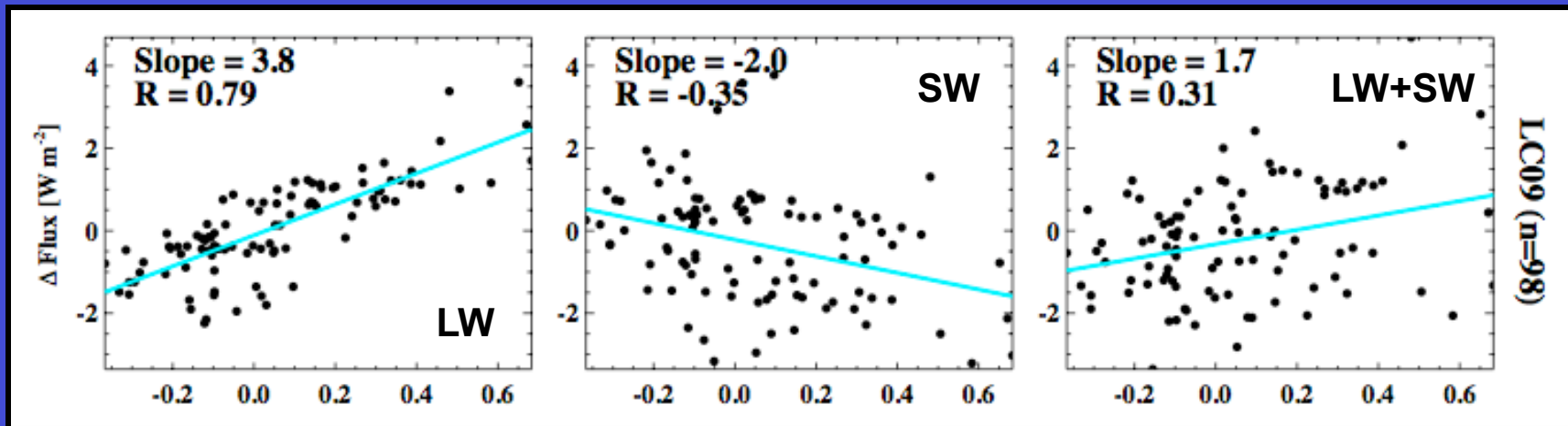
# LC2009 Method: AMIP Results



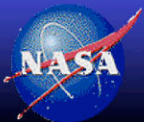
- LC2009 gave a mean value of  $-2.3 \text{ Wm}^{-2}/\text{K}$  for their total (LW +SW) flux changes with SST from 11 AMIP models
- Our 9 AMIP models return total flux results ranging from  $-0.1$  to  $-2.4 \text{ Wm}^{-2}/\text{K}$  with a mean value of  $-1.4 \text{ Wm}^{-2}/\text{K}$ ; smaller than LC2009's.
- We also found similar data issues (i.e., smoothing all data and effects of changing endpoint) as those found in ERBS data. LC2009 method is statistically unreliable.



## ERBE Results from All-points Method



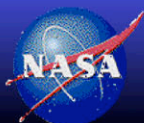
- The traditional “all points” approach for data from the 9-period is not sensitive to beginning-point and end-point issue and should provide a more robust result
- Using all data for the 9-period, not just the beginning and end points, ERBE Ed3\_Rev1 data gives LW/SW/LW+SW results of 3.8/-2.0/1.7  $\text{Wm}^{-2}/\text{K}$ , respectively



## Results from All-points Method (Cont.)

	<i>LC2009 results (GRL)</i>	LC2009 method Ed3_Rev1 Smoothing	All-points method Ed3_Rev1 Smoothing	All points method Ed3_Rev1 (36-day)	All points method AMIP Models
LW	<b>3.5</b>	1.8	3.8	$3.3 \pm 1.0$	$1.8 \pm 0.4$
SW	<b>1.0</b>	-1.3	-2.0	$-2.7 \pm 1.6$	$-1.1 \pm 0.7$
LW+SW	<b>4.5</b>	0.5	1.7	$0.7 \pm 1.4$	$0.7 \pm 0.6$

- There are significant uncertainty (2-sigma) in the observed monthly mean or 36-day mean results due to random response of the system in the short time scale
- AMIP results have smaller values for both LW and SW; but very similar value for LW+SW
- Differences between observations and model results are within (or very close to) their combined 2-sigma uncertainty



## Summary

- LC2009 results for LW are too high (SST dataset issue); SW results have the “wrong sign”. The combination of these two factors causes the LW+SW results to extremely high positive values
- Their results are not affected by Rev1 correction
- Smoothing all data (not just the SW) further reduces the observed LW+SW change to SST
- Their LW+SW AMIP model results are also too high
- LC2009 method is statistical unreliable and can change significantly depending on the beginning-point and end-point of their data periods
- The traditional all-point method gives more robust results and is not sensitivity to beginning- and end-point issue
- Differences between observations and model results are within (or very close to) their combined 2-sigma uncertainty

